IMPLEMENTING AUTONOMOUS VEHICLE IN THAILAND: CONSUMER PERCEPTION

PATTARAWIT JANSUPARERG

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……
Mr. Pattarawit Jansuparerg
Candidate

……
Suparak Suriyankietkaew,
Ph.Ds.
Advisor

……
Asst. Prof. Winai Wongsurawat,
Ph.D.
Chairperson

……
Assoc. Prof. Annop Tanlamai,
Ph.D.
Dean
College of Management
Mahidol University

……
Benjalux Sakunasingha,
D.B.A.
Committee

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PATTARAWIT JANSUPARERG 5749203

M.M. (MARKETING AND MANAGEMENT)

THEMATIC PAPER ADVISORY COMMITTEE: SUPARAK SURIYANKIETKAEW, Ph.Ds., ASST. PROF. WINAI WONGSURAWAT, Ph.D., BENJALUX SAKUNASINGHA, D.B.A.

ABSTRACT

Autonomous vehicle is now being developed which we can foresee that the technology will change human lifestyle of individual transportation in the future. Considering about implementing this technology in Thailand, exploring and understanding Thai consumer would be an essential for success developing the technolgy for Thai user. From the study conducting by focus group, Thai drivers percieve that there are many factors involving for driving on Thai traffic which might cause from driver or road conditions. Also, Thai drivers can perceive benefits of the technology meanwhile many concerns factors need to be solved and communicated to consumer in order to gain acceptance level.

KEY WORDS: Autonomous Vehicle / Self driving car / Driverless car / Consumer perception / Thai Driver / Thai Traffic

26 pages

CHAPTER I
INTRODUCTION

1.1 Background

Developments in automotive industries never stop moving thanks to a supported technology that could help automobile manufacturer to develop a car becoming more advance. Exterior design, interior design, efficiency and safety have been developed to serve customer requirements i.e. Fuel efficiency, CO2 emission, comfortable, safety concerned, look and feel, etc. (Fagnant & Kockelman, 2015). Living in a car being a passenger or a driver, also pedestrians themselves still being in risks for road accidents. Definitely, everyone would like to go back home safely. To reduce risk of road accidents, especially human error causes, implementing automation system in a vehicle are expected to help in decreasing road accident. Moreover, driverless technology (Autonomous Vehicle) may help to improve traffic congestion also change in human behavior in the future. In macroeconomics point of view, the driverless technology would help to decrease accident cost, fuel cost, parking cost which estimates of annual economic benefits from AV in the United States reach $196 billion (Fagnant & Kockelman, 2015). However, concerned factors on this technology still need to explore. Vehicle cost, liability, security and privacy concerned are barriers of succession in implementing technology. Moreover, cyber-terrorist also a concerned issue. Once it happened, it would effect to all transportation also human safety. However, this matter is being developed by automobile manufacturers to make it more reliable.

As Thailand is a location of many car manufacturers for domestic and export to other countries, we can assume that automobile producer will produce AVs in Thailand and it has a possibility to sell to Thai consumers in the future. Understanding consumer awareness about AVs would be an important part of success implementation. From time to time, researches about consumers perception on AVs

issue still limited in the US and European meanwhile it is unable to find a research on Thai consumer's perception.

1.2 Research Question

How is Thai's consumer perception toward Autonomous vehicle technology implementation in Thailand?

1.3 Research Purpose and Objectives

To explore Thai consumer perception toward Autonomous vehicle technology implementation in Thailand and finding factors that could be drivers and barriers for success implementation of new technology.

1.4 Research Framework

This research will be a part of exploring consumer behavior and perception toward new technology in early stage together with finding limitation and complexity of Thai road condition. Since the technology has been developed in other countries, it has potential that AV might not fit with Thai road condition. Therefore, consumer research focusing on Thailand context which includes Thai consumer and Thai road condition are necessary aiming to access consumer motivation also factors to use and not use AV.

CHAPTER II
LITERATURE REVIEW

Human dreams having a car which not require a driver is becoming reality. Autonomous car, Autonomous Vehicle (AV), self-driving car, driverless car, robotic car have been developing rapidly after the U.S. Defense Advance Research Project Administration (DARPA) challenged the team who worked on developing Autonomous car for a prize. AV can be categorized as five levels suggested by the National Highway Traffic Safety Administration (NHTSA) (James M. Anderson, 2014) which each level has different benefits and level of automation:

Table 2.1 The five levels of AV suggested by the National Highway Traffic Safety Administration (NHTSA)

AV Level	Benefits and Level of Automation
Level 0	The Human driver is in complete control of all functions of the car
Level 1	One function is automated
Level 2	More than one function is automated at the same time (e.g., steering and acceleration), but the driver must remain constantly attentive.
Level 3	The driving functions are sufficiently automated that the driver can safely engage in other activities.
Level 4	The car can drive itself without a human driver.

2.1 Situation of AV development

Many automobile manufacturers also capture the trends of AV which expected entirely success and available in the 2020s. Volvo, the safety-oriented automobile manufacturer, stated that “no accidents involving Volvo cars by 2020” (Volvo Cars Corporation, 2016). Leading automobile company such as Audi, Ford,

GM, Honda, Mercedes, Nissan, Toyota and Tesla also pay attention in developing AV. Moreover, other innovation companies like Apple, Baidhu, Delphi Automotive (automotive technologies manufacturers) and Google are also trying to develop the technology aiming to supply to OEM (Kulikowski, 2015). From the time being, the 2010s, people keep eyes on the AV development project and there were many cases published. For example, in September 2014, Google's self-driving car had been run in autonomous mode over 1.3 million miles which 424,331 miles were on the public road. However, Accidents from Google's self-driving car also had been reported which some of the accidents did not cause from the software (Korosec, 2016).

2.2 Safety system in Automobile

In the beginning, when safety on the road became concerned, out of the car chassis, safety belt and airbag (SRS) would be the feature that people are thinking of. Recently, since the technology became more advanced which can be integrated and equipped in a car, there are many safety features that able to reduce accidents not only safety belt and airbag. The safety system in an automobile can categorize into two types which are Passive safety and Active safety. Passive safety is a system that will support passengers during an accident meanwhile Active safety are a system that supports passengers before an accident. For example, Rearview Back-up Cameras, Parking Sensors, Forward Collision Warning with Automatic Braking, Adaptive Headlights, Blind-spot detection/side assist/collision warning, Lane-departure warning, Emergency brake assist/collision mitigation. These technologies interact with the driver as a warning, meanwhile, some of its can control vehicle operation (brake, steering, throttle). From IIHS reports, it is shown that an improvement of vehicle design could help in decreasing of death rate from the accident as shown in figure 2.1, figure 2.2 and figure 2.3 (IIHS, 2015). In the future, an autonomous vehicle would be another step of technology expected to reduce death rate and accident rate on the road.

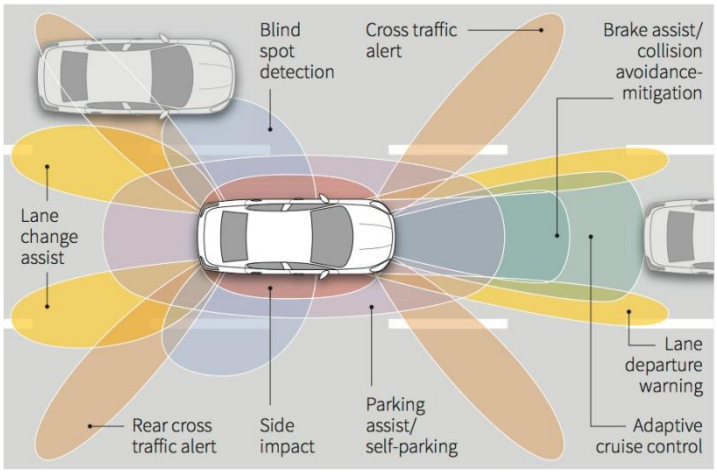

Figure 2.1 Driving Assistant System (IIHS, 2015)

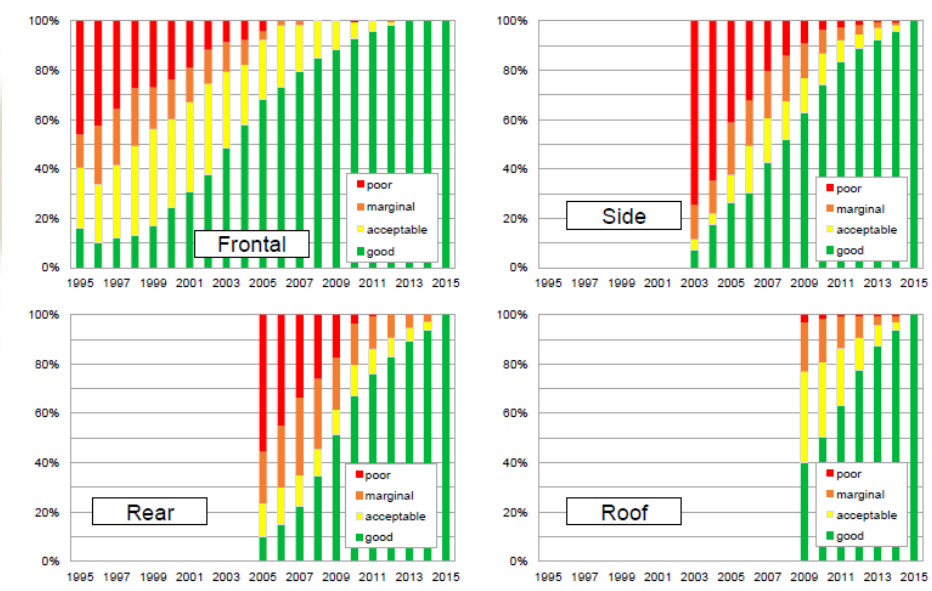

Figure 2.2 An improvement of crash protection rating (IIHS, 2015)

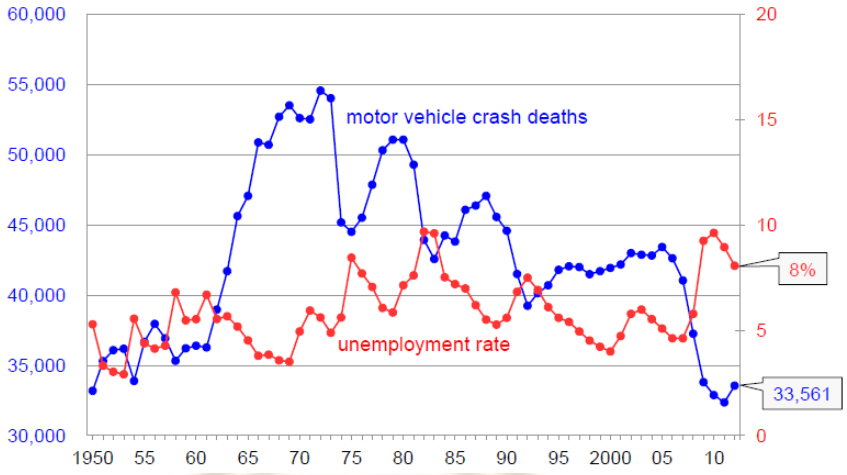

Figure 2.3 US motor vehicle crash deaths 1950-2012 (IIHS, 2015)

2.3 Driving assistant technology implementation in automobile

In the past, before AVs, cruise control, and speed limiter were the technology to support and improve driver's convenience. Drivers could let the car operate itself but the driver still has to monitor, control and override in case of emergency. There was a study about user's opinions using cruise control and speed limiter systems in Europe after the technology are available in cars (Pereira, et al., 2013). The research approached by the qualitative method, focus group, found that drivers frequently use cruise control rather than speed limiter regarding low acceptance levels, perception and other less restrictive system that able to provide the same benefits meanwhile the theoretical effectiveness, perceived usefulness, satisfaction might not be evident in daily driving. Additionally, lack of knowledge in using the technology also the cause of infrequent using. The research also found that once users can utilize the cruise control and speed limit systems, users might consider non-activity such as talking on the phone, eating, writing or even watching movies.

2.4 Failure of Automation System

Since AV is operated by automation while human just sits behind and monitor, the interaction between automation and human had been studied in the case

of automation system failure (Strand, et al., 2014). The hypothesis was that driving performance will effect by the level of automation. The research conducted by a driving simulator involved by 36 participants. The results showed that driving performance decrease when the level of automation increases because human tend to pay less attention to activity when automating mode activated comparing with manual driving which requires the driver to pay attention in controlling a vehicle.

2.5 A pilot study of future autonomous driving experience

There was a study about setting the stage for autonomous cars aiming to gain acceptance and to understand users response to the technology together with understanding what possible benefits or difficulties they perceive (Pettersson & Karlsson, 2014). Two different qualitative approaches had been conducted to explore users' expectations for future automotive technology. The first study conducted by drawing, collaging and interviewing while the second study used drawing and enactment of expected use to simulate a change in technology from current scheme to future scheme. Results from study shown that AV's user perceive its value in term of time management, safety, efficiency, comfort meanwhile trust and worries still being concerned. Moreover, once the technology could reduce the level of human control and operation, AV's user expected that the car would be a place for engaging others activity such as reading, relaxation, working socializing, eating, tending children, video entertainment and etc.

2.6 Thailand road accident

A number of road accidents in Thailand still increase every year as shown in figure 2.4 (Statistical Forecasting Bureau, National Statistical Office Thailand, 2013). The primary cause of accident came from human factors (Exceeding speed, Drunk driving, Tailgating) following by an environment and equipment. Vehicle safety features still not widely use and still limited in the high range such as European car or top of product line which consumer needs to spend with lots of money. On the

other hand, in a lower range, safety features also available with a limited number of features.

However, as automotive producers focus on developing Autonomous vehicle, sooner or later, this technology will be available in Thailand. Understanding Thai consumers perception would be a major role of succession in developing an autonomous vehicle adapt to Thailand context.

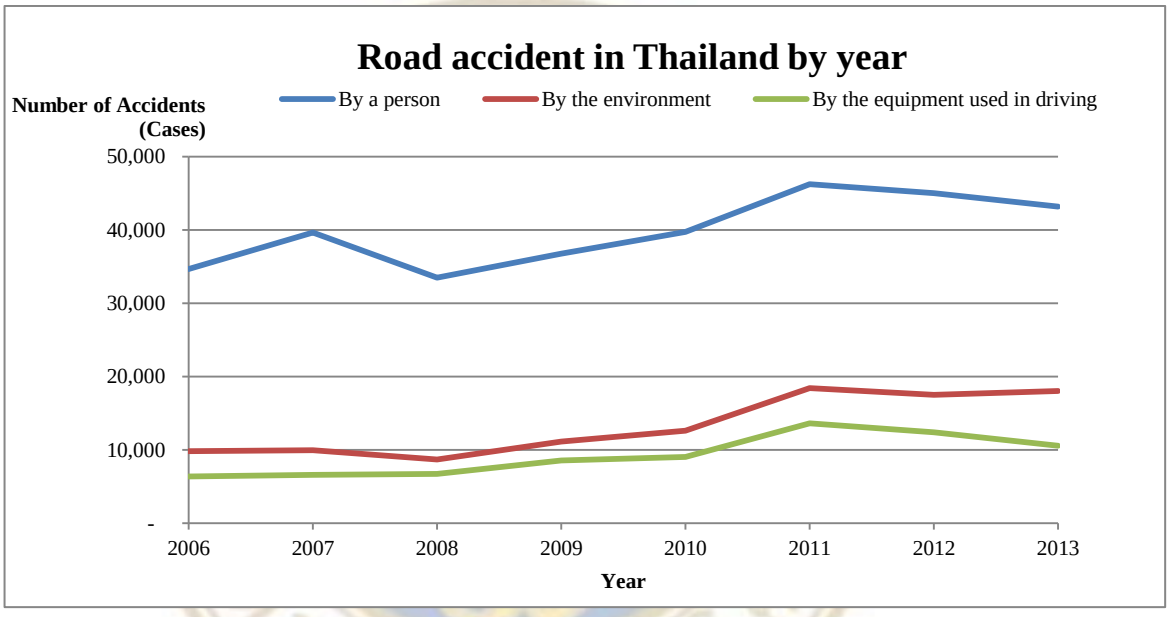

Figure 2.4 Number of Road Accidents in Thailand 2006-2013 (Statistical Forecasting Bureau, National Statistical Office, Thailand)

CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Methods

Since AV still in early stage of product's life cycle and have a limited awareness among Thai consumers, using exploratory research technique would help get understanding their perception and motivation to the new technology rather than quantitative (Gilbert A. Churchill & Iacobucci, 2005). The qualitative research results are an expressive description which can clarify qualities of characteristics related to an objective. Alternately, quantitative research is a tool to get data to explain hypothesis in term of the number which suitable after exploratory research has been done (Sekaran, 2003). The quantitative technique may not match with the current status of this technology since AV is in the early stage of product's life cycle and its awareness still in limited numbers of people. Moreover, considering quantitative method, we might not understand in depth since research question is not open end. Therefore, the qualitative research is suitable tools to help understand variables on AV. Qualitative research also has many methods such as focus group and depth interview. Focus group, which normally consists of six to ten members, will be conducted in this research regarding its unstructured, free-flowing, able to introduce the topic and encourage group members to discuss freely which would lead to the depth expression (Zikmung, 2000).

3.2 Studies and procedures

The focus group was separated into three parts which are first stage question, video presentation, and second stage question. Firstly, the participants were brief about research objective of AV then they were given a first stage question to pull their attention and make them focus on the topic. The first stage questions were about driving experiences, obstacles while driving a car in Thailand, factors concerning

when purchasing a car and asking about the understanding of safety system in a car. Then, the participants were given a video presentation explaining about the history of AV, how it works and the status of development (The Future of Driverless Cars, 2015). After watching the video, the second stage questions scoping about AV were given to participants for sharing their perception, opinions and some discussion between participants.

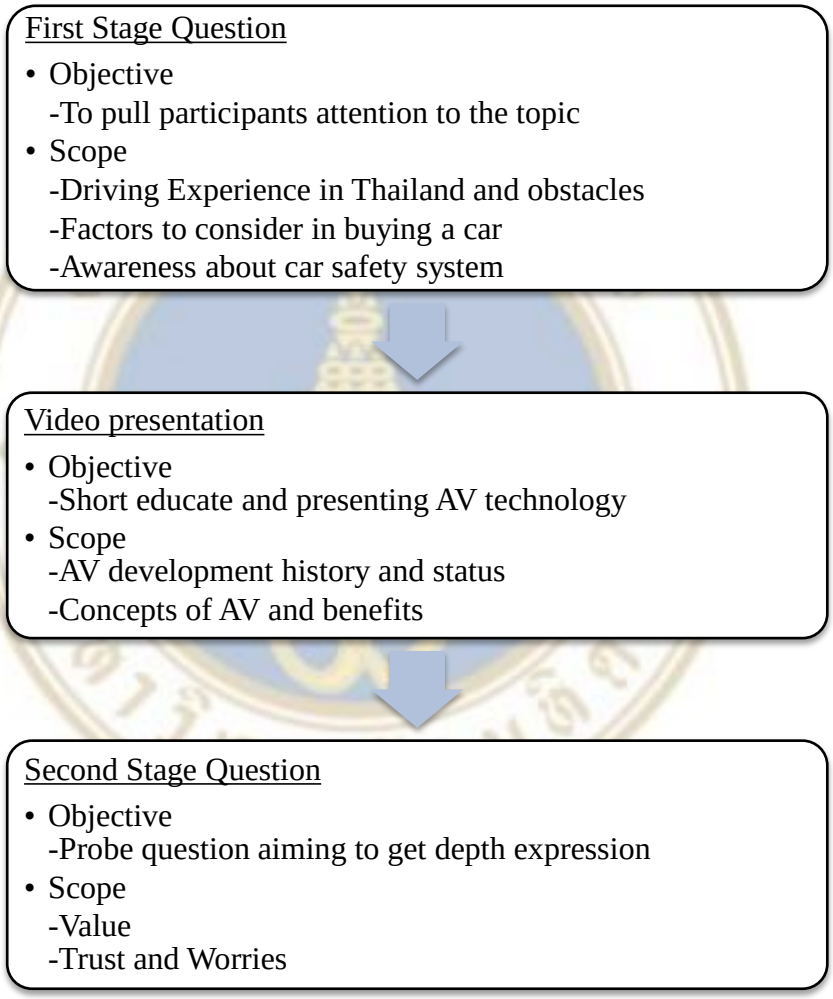

Figure 3.1 Research procedures (Jansuparerg, 2016)

3.3 Participants

The focus group members consisted of seven persons, three men, and four women, with different backgrounds at the age range between 25-35 years with experiences in driving. The reason to focus on this age is that the AV technology will be implemented in the year 2020-2025 (4-9 years from now on) and the majority of the people who have the purchasing power to purchase a car which normally at the middle age.

Table 3.1 Focus group participant profiles

Participants	Age	Driving Experience	Frequent traffic condition
M1	31	11	Urban & City
M2	28	13	City
M3	25	12	City
W1	35	15	City
W2	30	12	Urban
W3	26	8	Urban & City
W4	25	7	City

CHAPTER IV
RESEARCH FINDING

Research finding could be divided into three parts which consist of Thai driver's background & perception toward Thai individual transportation, potential drivers to use AV and potential barriers to use AV as shown in Figure 4.1.

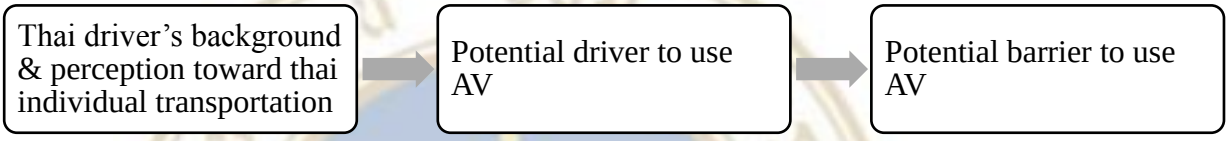

Figure 4.1 Flow diagram of research finding (Jansuparerg, 2016)

4.1 Thai driver's background & perception toward Thai individual transportation

4.1.1 Driving experience

The participants started to drive during teenage. The majority of them started since university age which around 18-22 years old while some of them started since early of teenage approximately 13-15 years old which counting in experience would be around ten years. Thus, the driver could learn and understand the traffic since they were young.

4.1.2 Difficulty in driving on Thai road

In the city**,** Traffic jam, Bad driving behavior, and Motorcycles play important roles as obstacles to drive in the city. For example, it can be found that Thai drivers have low discipline which does not respect to regulation and lack of manner. Pressure from the car behind, improper speed and unpredictable behavior such as not

giving turning signal or sudden lane changing could be easily found while driving in the city. On the other hand, a factor from driver themselves such as lose focus on driving to an advertisement, radio, phone calling or even drowsiness also important personal factors as a difficulty in driving. Out of human factors, road condition also is an obstacle such as poor road surface and roadworks.

In the case of urban condition, most of the factors are same as driving in the city such as heavy traffic, poor road condition, drowsiness, the improper distance between a car and not giving a signal when they change lanes. Moreover, in the urban area, motorcycles are usually not going to the right direction. They usually ride a motorcycle across the road wherever they want or riding in the opposite direction which makes a car driver to pay higher attention to drive.

4.1.3 Factors to consider in buying a car

There are a lot of factors which also depends on their interest. Most of the participants pointed that Brand image would be the first priority to consider at the first stage. Then, performance, feature and safety system could be a factor for them to consider buying a car after considered a brand while the last factor is the budget. Base on the focus group, this information are quite broad and general which are better to continue exploring in quantitative research because the question that participant had been asked were about to pull their attention to the focus group topic.

4.1.4 Safety system awareness

Lack of knowledge in technology could effect to frequent of use (Pereira, et al., 2013). Thus, to understand about awareness is necessary for considering a strategy to implement new technology. The participants from the focus group, all of them, know both basic safety features such as safety belt, ABS, airbag and new technology features such as stability control, lane departure warning, and lane keeping assist, camera, and sensors. They also understand about its benefits of each feature together with how to use and occasion of use.

Table 4.1 Research finding - Thai driver's background & perception toward Thai individual transportation.

Thai driver's background & perception toward Thai individual transportation	**Summary**
Driving Experience	2/7: Started driving in high school 5/7: Started driving after graduated University 7/7: Current driving experience around 13-15 years
Difficulty on Thai road	3/7: Motorcycle 7/7: Traffic jam 5/7: Road surface 7/7: Bad driving behavior 3/7: Pressure from car behind 3/7: Not giving turning signal 5/7: Improper speed 4/7: Lose focus from activities 3/7: Drowsiness 3/7: Improper distance while driving
Factor to consider in buying a car	7/7: Brand image 4/7: Performance 3/7: Feature 3/7: Budget.
Safety system awareness	7/7: Safety belt 7/7: ABS 7/7: Airbag 4/7: Stability control 3/7: Lane departure warning, 3/7: lane keeping assist 2/7: Camera and sensors

4.2 Potential Driver to use AV

4.2.1 Value and benefit

The participants were interesting on AV technology and believed that it would change the lifestyle of individual transportation. They perceived that they can have more free time from reducing paying attention to drive, and they would consider others activities such as eating, sleeping, family time, reading a book, working and using a mobile phone instead. Some of the women participants who have less skill to park a car she expected that technology could help her to park a car and able to drive in a parking lot in building and small road automatically. Some of men and women commented that it may reduce driving experience, and it would be less fun to drive with this technology. Moreover, the participants (men) suggest that AV technology would be suitable for mass transit system such as a bus.

Table 4.2 Research finding - Potential Drivers to use AV

Potential driver to use AV	**Summary**
Value and Benefits	5/7: Time-saving 7/7: Alternative activities: (eating, sleeping, family time, reading a book, working, using mobile phone) 2/7: Automatic parking 3/7: Reduce fatigue 2/7: Suitable for Mass transit system

4.3 Potential Barrier to use AV

4.3.1 Trust and worries

The participants concerned that the AV technology may not completely work in Thai road condition as mentioned before about difficulty in driving on Thai road. Out of those factors, system liability also becomes an important factor in using

AV technology. The participants concerned about the situation of system failure which may cause an accident. Product testing also product development for Thailand road conditions would be a tool to make consumer confidence in technology, mentioned by participants.

4.3.2 Human roles in driving

Since AV technology will be replaced and operated instead of a human, the problem is that when an accident occurred, the responsibility will belong to human or AV. In a focus group, participants have a question about how fast of reaction to critical situation comparing between human and AV. They also comment that a research comparing performance between human and AV could make them more confidence in technology. Furthermore, the men participant suggested that human should have the authorization to override system and able to choose auto or manual mode by themselves.

4.3.3 Cost increment

The participants were given a price list of a car that provides full safety features for both passive safety and active safety which the price gap of the model that have full feature compared with standard feature model up to 300k-500k Baht depends on the brand. For D-segment, the highest Japanese model probably has the same price as European car with the standard feature. Some of the participants commented that "somehow, with cost increasing, it had better choose European car since it has better image." In contrast, some of the participants prefer to spend more for the higher feature, ability, and technology which would provide them more benefits.

4.3.4 Privacy concern on data

AV technology requires connections and communications also information exchange. In term of privacy concern, all the participants had given comment in the same direction that car owner should have rights over their own data which require permission to disclose and tracking for another purpose which is not related to the transportation system.

4.3.5 Hacker / Terrorist

Half of the participants have different direction about hacker and terrorist concern. One side of participant commented that it would be difficult to hack since another platform such as Facebook still difficult to find a case. Moreover, they hope that they can switch to a manual mode which can disconnect to the hacker. The other side gave the opposite comment that the car generally controls by ECU (electronic control unit) which it is still able to operate even driver disconnect a car from communication.

Table 4.3 Research finding - Barrier to use AV

Potential Barrier to use AV	**Summary**
Trust and Worries	7/7: It might not match with Thai road condition 6/7: System failure
Human role in driving	5/7: How to define accident cause 5/7: Question about human role in driving 4/7: Overriding authorization 4/7: Question about machineability compares human
Cost increase	3/7: Rather consider European car 3/7: Willing to spend more for better technology 1/7: Still need to consider
Privacy concerned	7/7: Permission required 7/7: Rights over data belong to owner
Hacker/Terrorist	4/7: not too much concern 3/7: concern 4/7: Ability to switch manual mode required

CHAPTER V
CONCLUSION AND RECOMMENDATION

5.1 Conclusions

Thai drivers started to drive a car since their university life or even earlier. The drivers may have experience and behavior which already became an instinct. Thus, considering changing their attitude would take lots of time, and it may take lots of effort to make change success. Therefore, giving a real experience to the users would help them to learn and understand new technology rapidly. Moreover, after the users can learn and understand about new technology, the users can be one powerful customer voice to share their experience with others and influence others to interest the new technology.

According to focus group activity, the participant interested in AV since they could perceive value and benefits of the technology which would make them convenience and able to spend their time efficiently. The participants also expect that it would help to change their lifestyle also change a scheme of mass transportation system. However, since technology still under development stage and it has not been tested in Thai road condition, the participants still have concern points on trust in technology, the reliability of how AV operate under Thai traffic conditions, human roles in driving and responsibility for an accident, cost increment, data privacy and hacker issue. The participants comment that the concerned factors could make them consider not using AV until it has been proved that it is suitable and safe to use under Thai traffic conditions.

5.2 Research limitations

This research was conducted under time limitation. Therefore, the study covered only exploratory research scoping on Thai context and potential user of AV which are general users. Moreover, the focus group participants contained by general automobile users only which were not included others vehicle such as motorcycles, taxi, bus and truck also not covered to mass transportation system and logistics system. Out of user perception, research for road infrastructure for AV also legal related still need to be considered for further research. However, to continue this research, quantitative should be considered to study as larger scale and to find that the variables from exploratory research are relevant to Thai consumers in large scale or not

5.3 Concept to approach and Action Recommendation for Success Implementing AV in Thailand

5.3.1 The concept to approach

The concept of marketing management tasks and Customer perceived value are taken to apply in a recommendation for successful implementing AV in Thailand. The marketing management tasks can be applied to marketing team are about capturing marketing insight, connecting with customer, delivering value, and communicating value are important in term of developing a product to satisfy customer, assuming that automobile producer already connected to the customer and have a strong brand. In parallel, Customer perceived value (CPV) could be a core concept to apply for success implementing AV in Thailand. “CPV is the difference between the prospective customer’s evaluations of all the benefits and lost all the cost of an offering and the perceived alternatives.” (Kotler & Keller, 2012). Not only marketing task to be focused, but marketing also has to collaborate with R&D team to ensure that messages from the customer are delivered to R&D with the same meaning. Thus, refer focus groups activities gathering all factors that could be barriers and

drivers to use AV, the concept to approach AV in Thailand could be elaborated as figure 5.1.

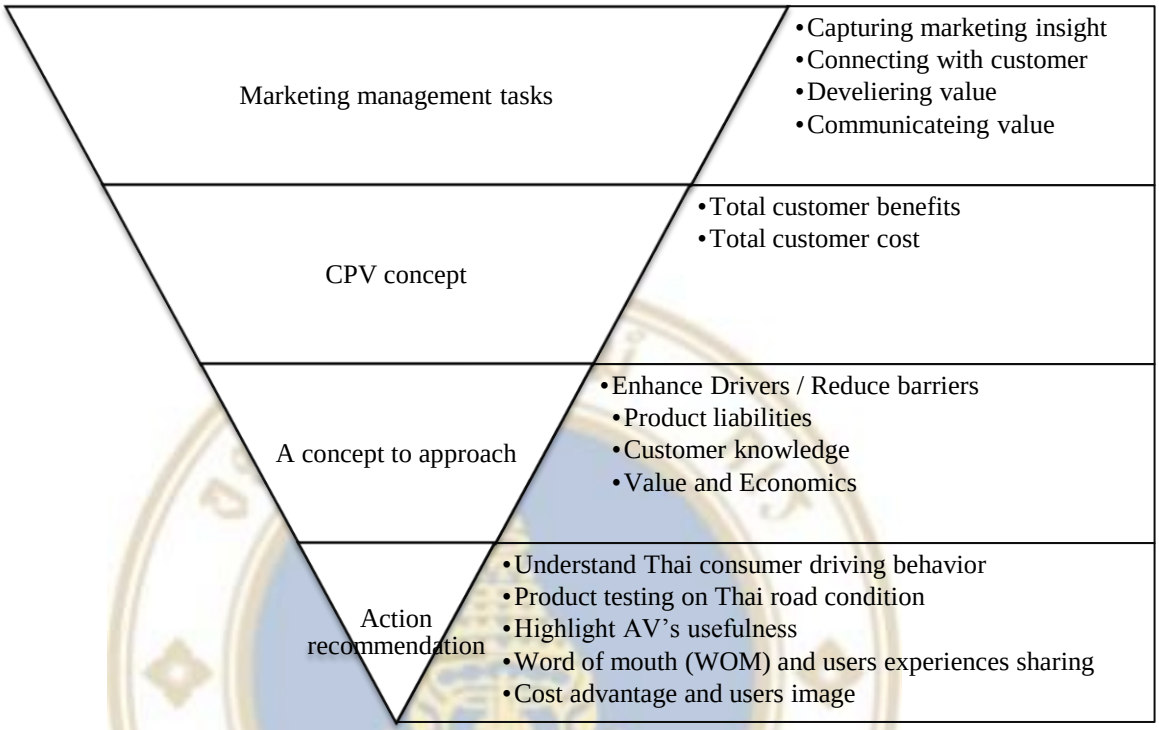

Figure 5.1 Concept to approach AV in Thailand (Jansuparerg, 2016)

Focusing on Action recommendation from figure 5.1, the concept is about to enhance the weight of drivers factors and reduce the weight of barriers factors as show in figure 5.2. As a result, the customer would perceive product value which would make a decision to purchase easier.

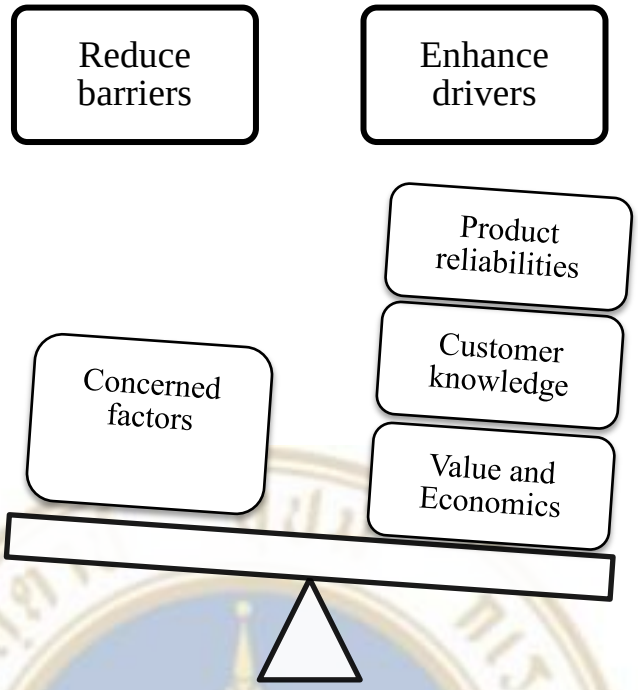

Figure 5.2 Action recommendation concept (Jansuparerg, 2016)

5.3.2 Action recommendation

5.3.2.1 Enhance product reliabilities by developing technology base on Thai road condition

Understand Thai consumer driving behavior: It could be predicted that automobile producers already have market research to understand Thai consumer behavior which typically apply for product development to fit with Thai consumers. However, AV is a new technology which might have high impact on transportation system also an automotive business. Therefore, since automobile manufacturer already has their own database, it would be helpful if the automotive maker who already have a plan to implement AV to have some cooperation by sharing each other about understanding Thai consumers who would lead to success in developing a product to fit with Thai consumers. As a result, if AV is accepted by Thai consumer and widely use, AV technology might be able to deliver its benefits which can change the lifestyle and the definition of transportation. On the other hand, in the case of automobile producer not sharing each other and consider to develop AV individually and it turned out that AV could not fit with Thai consumers, or even just a

few brand can make it success. It may have possibilities that AV might not widely use. Then, AV's benefits might not fully deliver to users. Therefore, users may not perceive usefulness and AV implementation may not success in the end.

Product testing: Currently AV development and product testing are in the US. To develop AV for Thai consumers, it is essential to have product testing under Thai road condition since Thai road conditions are complicated as per the participants in focus group mentioned. This activity could help to increase reliability and make consumer confidence that they can use AV on Thai road safely.

5.3.2.2 Educate consumers about technology

Highlight AV's usefulness: Implementing new technology and motivating the consumer to use, consumers need to perceive usefulness and satisfy the technology. Then, they will decide to use. If consumers could not understand buying reasons or even the could not perceive usefulness and benefits. It might be difficult for them to change from the existing that they are already familiar. According to focus group activity, after participants had watched a video about AV which mentioned about its ability, the participants seemed interested in the technology after the can perceive its usefulness through a video presentation. However, the participants comment that they would be more confidence in technology if the concerned factors can be solved. Therefore, communication is necessary as well as perceive of usefulness.

Word of mouth (WOM) and users experiences sharing: Nowadays digital advertising play as important role in marketing and communication. In the past, people share their experience via offline WOM such as face-to-face and telephone. But nowadays, online WOM such as email, instant messaging, texting, chat and blog become another channel in communicating WOM which is faster and easier to reach (Stephen, 2016). Thus, positive and negative WOM become more visible among consumers. In order to communicate to consumers, online and offline WOM should be considered and handled well especially contents which its goals and objectives should be defined clearly. The content that would increase customer attractiveness should be about product benefits, product demonstration on real Thai road situation and users experiences. Then, when people aware and perceive its usefulness, they will try to study more and take into their consideration about to accept

this new technology. As a result, if consumers do not get struck about its benefits and concerned, they would consider about cost as a next step.

5.3.2.3 Value and Economics

Cost advantage and users image: Brand image, product image are important factors for Thai consumers mentioned by focus group participants. If products can enhance consumer's social status, it could be able to stimulate consumers a one of their buying factors. Not just only about image, cost advantage also to be considered when consumer purchases a car. Maintenance cost, depreciation cost and add up cost before and after purchase should be taken into consumer consideration factors which also mentioned by participants. Therefore, pricing strategy would take an important role that can motivate consumers also demotivate them as well. Product selling price, price structure, product line up and addition cost which occur after purchasing should be handled well and planned strategically. Value pricing or discrimination tactic could be a tool to set product price. AV manufacturer can take benefit by offering product value to the customer which customers are willing to pay more for benefits. On the other hand, not all customer are willing to pay more, price discrimination tactic could be applied in order to motivate the customer to use new technology rather than old technology.

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